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# American Potato Journal

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## OMIT BLACK LEG FROM THE CERTIFICATION REGULATIONS

A leading dealer in one of the Western States recently wrote that he had sold more than 70,000 sacks of seed in one potato-growing section. He stated that the seed was free from disease but that, "due largely to weather and soil conditions some of it showed black leg." The growers now insist that the seed should not have been certified.

Many of the difficulties between the producer and the consumer of certified seed potatoes have arisen from the fact that the consumer has been improperly advised concerning what he can expect when he purchases certified seed potatoes. Many believe, for example, that when they purchase certified seed, this should be free from rhizoctonia. The consumer must be advised that it is partly his responsibility to see that this disease is eliminated from the seed.

The situation with regard to black leg is particularly bad, for if black leg is found in the crop the grower places the blame on faulty certification. This is to be expected in view of the fact that the certification authorities have implied that black leg, like mosaic and leaf roll, could be largely eliminated by the usual field and tuber inspections. There is sufficient evidence to show that this is not the case. Leach in Minnesota and Bonde in Maine have demonstrated that the disease is carried only to a slight extent in seed potatoes.

Those in charge of certification have made an important contribution to the potato industry. It is now possible for the potato grower to purchase seed potatoes reasonably free from serious diseases. In our efforts to sell certified seed, however, we have made some promises which cannot be kept. This is particularly true in the case of the black leg disease. The purchasers of seed potatoes should be advised of the fact that this trouble cannot be eliminated by certification. It is very much to be desired that the recommendations in connection with this disease made at the Baton Rouge Conference be adopted by all states certifying seed potatoes.

# MATURITY OF POTATO SEEDLINGS IN THE GREENHOUSE AND THEIR LATER BEHAVIOR IN THE FIELD<sup>1</sup>

F. A. KRANTZ

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Early separation of individuals according to their maturity is often desirable in breeding work. It has been observed that when potato seedlings are started from seed they may vary in the number of days required to mature in the greenhouse. Tests have been conducted to study the significance of this variation in maturity and its relation to the behavior of later clonal generations in the field.

In breeding work, potato seedlings are usually started in September and harvested in February. In 1936 and 1937 the individual seedlings were recorded as the vines died in the greenhouse. These individual readings were then used to secure the average mean number of days to maturity for each family. The use of four randomized blocks allowed the variance in maturity due to hereditary differences between families to be separated from the variance caused by environment. Since a different group of families was grown each year, the data for the two years are presented separately. The analysis of variance is presented below:

Variation Caused by	1936		1937	
	D. F.	Mean Square	D. F.	Mean Square
Families	50	51.2*	67	234.7*
Blocks	3	88.1*	3	182.9*
Error	150	14.6	201	52.9

\*Values for F exceed the 1 per cent point.

It will be noted that the differences between blocks were significant, indicating that the location in the greenhouse influenced the time required for seedlings to mature. All observations showed that this difference was caused, at least in part, by the location in relation to available light. The variation caused by differences

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between families was significantly higher than error during the two years. Since the differences in the mean number of days to maturity between families can not be reasonably assumed to be due to chance, other probable sources of this difference must be sought.

Hereditary variations between families might satisfactorily explain the results. The mean number of days for maturity of progenies from early and late varieties crossed with selection 5-10-1 is given in table 1. The  $F_1$  progenies of crosses involving the early varieties, Warba, Early Ohio, and Triumph, required fewer days to mature than those from the late varieties, Russet Rural, and Jubel. The mean number of days to maturity of progenies from early varieties as a group differs significantly from that of the late varieties. These observations suggest that differences in maturity between families in the greenhouse are heritable and that the factors responsible for varietal differentiation for maturity in the field are also operative in differentiating their progenies in the greenhouse.

The differences in maturity obtained between families in the greenhouse could be used to advantage in breeding for early maturity providing the families reacted the same in the field. Seventeen of the fifty-one families harvested in the greenhouse during the winter of 1936 were grown in the field in 1937. This was their second clonal generation in the field. The maturity of these families

TABLE 1.—Mean maturity in the greenhouse of  $F_1$  families from individuals of varying maturity pollinated with selection 5-10-1

Pistillate Parents	Mean Number of Days to Maturity of Progeny
Warba	114.9
Early Ohio	118.5
Triumph	120.5
4-9-3-1-1-1-1-1	120.9
4-25-6	121.1
116.30-1	121.6
Russet Rural	122.8
Jubel	126.7

S. E. of difference = 2.56

was measured by the same methods as previously employed in the greenhouse. Since no family matured all of its seedlings before

harvest, an additional record was made at weekly intervals of the percentage of green foliage that remained beginning five weeks previous to harvest, and these weekly estimates were averaged to obtain a mean for the family. The data on greenhouse and field observations for the seventeen families are presented in table 2. An

TABLE 2.—*Maturity of each of seventeen families in greenhouse and in field*

Family Number	Mean Number of Days to Maturity		Per Cent of Foliage Green* 1937 Field
	1935-6 Greenhouse	1937 Field	
118.35	115	110	15
124.35	121	116	18
11-8-1-9-4	119	117	48
111.35	119	118	38
119.35	123	114	42
21-2-2	121	117	47
121.35	117	121	63
82-11	120	119	55
11-1-2-2-4	122	120	55
39.25	122	120	42
194.35	123	117	57
167.35	122	121	54
5-10-1	126	119	48
165.35	127	119	52
107.35	127	123	49
104.35	126	125	71
166.35	127	123	62

\*Average of observations each week for six weeks previous to harvest.

inspection of the data shows that there is an association between the greenhouse and field observations. The coefficients of correlation between the greenhouse and the two sets of field observations were .567 and .569.

The analysis of variance for the seventeen families in greenhouse and field shows that the mean differences for maturity between families, when the results obtained at the two locations are combined, are highly significant. The analysis is presented in table 3. It will be noted further that the variance for interaction of families with locations is no greater than that obtained for error. This can be interpreted to mean that the families reacted the same for maturity in the greenhouse as they did in the field, and that any

dissimilarity of behavior for maturity at the two locations could be reasonably ascribed to chance.

Further evidence of an association between maturity in greenhouse and field was obtained from observations on four families grown in the greenhouse in the winter of 1936-'37. The seedlings of the four families were each divided into five groups according

TABLE 3.—*Analysis of variance for maturity of seventeen seedling families grown in greenhouse in 1935 and in field in 1937*

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Families	16	645.38	40.34	3.2**
Locations	1	226.12	226.12	
Blocks	1	19.06	19.06	
Families x locations	16	177.38	11.86	
Error	33	414.94	12.52	
	67	1482.88		

\*\*Exceeds the 1 per cent point.

to the maturity of the seedlings in the greenhouse. The groups comprising each family were then grown in the field and observations were obtained on their maturity. The data are presented in table 4. A significant difference between the means for maturity

TABLE 4.—*Showing relation between number of days required for seedlings to mature in greenhouse and percentage of seedlings green at time of harvest in field*

Families		17-3 (121)*	17-2 (126)*	80-7 (129)*	9-1 (137)*	
Group	Mean Days to Maturity in Greenhouse	Field Immature Seedlings at Harvest				Total
		Per Cent	Per Cent	Per Cent	Per Cent	
1	100	22	22	45	44	133
2	110	36	55	58	40	189
3	115	46	55	45	50	196
4	120	55	51	53	55	214
5	125+	50	43	42	57	192
	Total	219	226	243	246	924

\*Mean number of days to maturity of family in greenhouse.



of the five groups was obtained. The groups within the families tended to mature in accordance with their behavior in the greenhouse with the exception of family 80-7 in which the groups show no particular trend.

The mean maturity of the four families in the field was consistent with their greenhouse behavior. The results of this experiment agree with those obtained from the other studies. They furnish additional evidence of an association for maturity between greenhouse and field.

#### SUMMARY

Significant differences in the mean number of days to maturity was obtained between families of seedling potatoes in the greenhouse. Progenies from crosses involving the early varieties matured more quickly than those from the late varieties. The coefficient of correlation for maturity between greenhouse and field was .56. The variance for interaction of families with locations was no greater than that obtained for error. This result indicates that in this experiment early and late families reacted the same for maturity in the greenhouse as they did in the field. A study of maturity in the greenhouse and field, with seedlings comprising four families, furnished additional evidence of an association in maturity between the greenhouse and field. The observations indicate that maturity in the greenhouse, when combined with field observations, may increase the reliability of the estimate of the breeding value of a parent for quick maturity.

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#### REPORT ON POTATO VIRUS DISEASES IN 1937

T. P. DYKSTRA<sup>1</sup>

*United States Department of Agriculture, Washington, D. C.*

This report comprises a review of some of the papers on potato virus diseases published in 1937.

Putnam (15) found in his comparative studies of the three viruses that mottle virus, the ringspot virus, and yellow mottle, belong to the same group. They were able to infect *Datura stramonium*, were not transmissible by *Myzus persicae* and were equally resistant

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<sup>1</sup>Associate Pathologist, Division of Fruit and Vegetable Crops and Diseases.

to inactivation by various chemicals. Yellow mottle is stated to be easily transmitted by plant juices and grafting, and is best characterized by its striking yellow mottling on tomato, producing bright yellow interveinal areas and very dark green bands of tissue along the veins. It is regarded as a further member of the "latent" or "X" virus group.

Gratia and Manil (9) experimented with both the tubers and seed of the potato variety Jaune d'Or, a carrier of mosaic virus X. The plants produced from both sources appeared normal, but the juice originating from the tubers was actively flocculated by the anti-X serum produced in the *Datura* plants into which it was inoculated the characteristic X virus symptoms. On the other hand, the juice of the plants derived from seed was non-infectious and was not flocculated by the anti-X serum. The authors consider that these results furnish conclusive evidence against the hereditary theory of virus perpetuation.

The same investigators report later (8) that Jaune d'Or seedlings raised from seed and devoid of virus X, were inoculated with the virus from a parallel series of plants derived from tubers, and when subjected later to a serological test, showed that they were in possession of the infective principle, lost through sexual reproduction.

Chester (5) established serological distinctions among the three latent potato mosaic strains—mottle, ringspot, and a strain of latent mosaic isolated from apparently healthy potatoes, which caused systematic infection without external symptoms in tobacco and *Datura tatula*. Not only did the precipitin technique used in these studies differentiate the virus strains, but it also gave some clues to their antigenic constitution.

Newton and Edwards (14) found that chicken antiserum was produced by three wing vein injections of 1, 5 and 2 cubic centimeters respectively at three day intervals with purified sap from *Datura meteloides* and *D. stramonium* infected with potato virus X. The blood samples were drawn eight days after the last inoculation. The antiserum formed a conspicuous precipitate when incubated for three hours at 37° C. with similarly purified sap of the same hosts infected with the virus X, but formed no precipitate when similarly incubated with purified sap from virus-free plants. Two tobacco ringspot viruses, one originally isolated from spinach and the other from tomato, were found, by means of the precipitin reaction through the use of antisera, to belong to the X group. Although distinct from each other and from other strains of the X virus, as judged by symp-

tom expression on several hosts, they possessed similar thermal death-points, longevities *in vitro*, and host ranges to those of the potato virus X.

Chester (6) observed that when neutral precipitates of potato virus X and its specified serum were acidified to pH 4.8 or below, the precipitate underwent dissolution and large amounts of the antibody survived the neutralization of this virus by its specific serum. Titration of the X virus with its immune serum showed that one unit of antibody is capable of combining with, and being saturated by any number of units of antigen from 1 to 8.

Gratia and Manil (9), carried on experiments to determine why the tobacco mosaic and X potato viruses are not transmitted to the progeny through the seed. They made an examination of the extracts of the pollen grains of healthy and mosaic tobacco, and X potato-infected *Datura*. Precipitin tests of extracts in physiological solution from pollen grains by means of antisera of healthy and diseased plants showed the viruses to be absent from the pollen grains, and other tests showed that the anthers were also uninfected. Similar extracts were then prepared from the green calyx, the discolored pink corolla, the white stamens, and the pistil of a mosaic tobacco plant. The tobacco mosaic antiserum flocculated the calyx juice in ten minutes, and that of the corolla in two hours, but the juice of the stamens and pistils both reacted negatively. Evidently the virus gradually becomes attenuated and ultimately disappears during the differentiation of the floral organisms. The transmission or non-transmission of viruses would not appear, therefore, to involve a problem of heredity but merely to represent an instance of the very erratic behavior of these infective principles regarding the localization in the various plant organs.

Hornig (11) made comparative tests of some of the different methods which have recently been suggested for the determination of the degree of infection of potato seed tubers with virus diseases. He used healthy and diseased tubers of the Sickingen and Erdgold varieties from various localities in his experiments. The copper tests gave useful indications in 60 per cent of the trials with the Sickingen variety but constantly failed with Erdgold. Neither the quartz lamp analysis of disks cut from tubers nor the pH values showed any difference between healthy and diseased material. Warthenberg's and Hey's (17) electrometric method gave useful results with strongly differentiated material of the Zwicka, Early Yellow and Erdgold varieties, but not with Sickingen. The healthy tuber

juice of the first named variety assumed in a phenol solution a darker discoloration than that of the virus diseased tubers, but no difference in degree of discoloration could be observed between the juice of healthy and diseased tubers of the Sickingen variety.

Wartenberg (18) discovered that the results of the so-called day plot experiments in Dahlem and of Berkner's and Hecker's work in Breslau indicate that in Germany the spread of the potato virus diseases in the field increases until sometime in June or July from the earliest to the later sown potatoes, after which the incidence and severity of infection in the later sown crops sharply decline, both in quantity and in seed value. The Dahlem day plot experiments were repeated by the author in 1935-'36, and although no definite conclusions could be reached regarding the precise date of the critical period since the varieties varied considerably, there was some evidence that potato crops are most susceptible to infection when the shoots breaking through the soil are exposed to a relatively high temperature. Excessive air dryness and sunshine during the first two weeks after the emergence of the shoots also apparently favor infection.

Wartenburg (H.), *et al* (17) conducted studies on the acidity of the tissue emulsion of potato tubers, and found that the tissue emulsions of degenerate potato tubers showed a tendency to alkalinity, indicating the predominance of a carbonate bicarbonate system, which is less prevalent in healthy material. The actual reaction values of the tissue emulsions of "degenerate," and sound tubers do not deviate appreciably from a mean hydrogen-ion concentration.

Bawden (2) has made a study of the viruses causing top necrosis (Acronecrosis). The results of his investigations show that top necrosis can be induced in different potato varieties by the potato viruses A, B, C, D and X. By inoculating the four varieties, Up-to-Date, Epicure, President and Arran Victory, either by grafting or needle inoculations with sap from infected potatoes, it has been possible to distinguish the six viruses studied with a fair degree of accuracy, in that top necrosis was induced on Up-to-Date by viruses A, C and D; on Epicure by B, C, D and X; on President by B and C, and on Arran Victory only by B; virus Y induced acropetal necrosis on Up-to-Date and President, and foliar necrosis was induced by virus D on President and Arran Victory.

Murphy *et al* (13) found that the Dutch potato mosaics corresponded almost exactly with the Irish. Super mild mosaic showed

the presence of virus A; alpha mosaic contained X, B, and a form of A; rugose mosaic (Institut de Beauvais) the veinbanding virus; Zeeland Blue contained X and a form of Y or A, and possibly an unidentified virus. Monocraat contained virus F and X, Magdeburger Blaue, X and B; interveinal mosaic on Bravo contained X and F., and crinkle mosaic on Bravo showed X and A. A combination of A and F resulted in yellow mosaic of the lower leaves, resembling Aucuba mosaic, but apparently distinct. They found that A, B, F, X, and Y appear to underlie most potato mosaics of favorable maritime climates.

Clinch *et al* (7) give an account of a comparative study of the symptoms and properties of Aucuba mosaic of potato, potato "tuber blotch," and a latent virus of the Dutch potato Monocraat. All three were readily transmissible by sap to potato and other solanaceous plants. The Aucuba virus caused a yellow mottle on the lower or middle leaves of all fourteen varieties tested, with cortex and pith necrosis on seven of them. The remaining two caused a similar but inconspicuous mottling of the lower leaves, or no symptoms at all. All three viruses produced identical diagnostic symptoms on *Solanum nodiflorum* and *Capsicum annuum*, consisting of brown, or purple bordered spots, followed by a rusty purple discoloration and mosaic. The thermal death point of all three viruses fell between 62.5 and 65° C., and longevity *in vitro* between two and six days were similar in the three viruses. The tuber blotch virus was transmitted by *Myzus persicae*, but only in the presence of virus A. This virus and the Monocraat virus are identical and probably correspond to the virus of pseudo net necrosis, the aucuba virus being a distinct but related form. The tuber blotch virus is designated F, and the aucuba mosaic virus G.

Bald (1) recovered a virus from Arran Crest showing a slight aucuba foliar mottling. No tuber necrosis was observed, but the virus was repeatedly recovered over a period of one year from tubers of affected plants. The presence of the virus failed to protect the plants from infection by Y type viruses, and various other hosts containing it readily succumbed to X and X + B. Severe necrosis was induced by the potato virus on pepper at 70° F., but at lower and higher temperatures the symptoms were milder. The properties of this virus correspond with those of the F type.

Köhler (12) states that, from the practical standpoint, the only viruses to be considered in the German potato-breeding program for resistance to viruses, are leafroll, Y and A. He states a further

simplification may be introduced by the close relationship, amounting virtually to identity, between the two latter, both of which are readily transmissible by rubbing and by *Myzus persicae* are transmissible to tobacco, and lose their virulence on the exposure of sap to temperatures above 55° C. A clear distinction should be drawn between "defensive resistance" and "tolerance" in a given potato variety toward a virus, the former being far preferable from the breeding point of view and implying the existence of constitutional protective quantities, whereas the latter does not exclude the risk of conveying "masked" infection to neighboring susceptible plants.

Schultz *et al* (16) carried on further experiments in connection with developing potatoes resistant to virus diseases. They found marked variations in the reactions of varieties and seedlings to these maladies. Some varieties never contract a given virus in the field, but do so in graft tests, whereas in others the disease is readily transmitted by both methods. Several hundred plants of seedling variety No. 41956 failed to contract latent mosaic either by leaf-rubbing or grafting, although Katahdin was highly resistant in the field, but became infected by grafting. This variety has been completely resistant to mild mosaic in field tests, but is not homozygous for this character as shown by the susceptibility of 9 per cent of the seedlings in a selfed progeny. No definite evidence of resistance to veinbanding mosaic was found, but the severity of the symptoms in different seedlings varied greatly. Similar variations were observed in tuber grafting tests with spindle tuber and leafroll, indicating that tolerance, if not resistance to those diseases, may be found.

Botjes (3) states that considerable differences have been observed in the virulence of the stipple streak (acropetal necrosis) virus of potatoes, which is harbored in a masked form by a number of Dutch varieties. The Zeeuwsche Blauwe virus is very virulent when transmitted to Eersteling (Duke of York) and slightly so to Noordeling and Mutinga 17, whereas the infective principle found in Eigenheimer severely attacks Noordeling and Mutinga 17, but causes relatively little injury to Duke of York. The Thorhecke virus is equally virulent to Duke of York, Noordeling and Mutinga 17. The variations in virulence are manifested both in tuber grafting and juice inoculation tests and are expressed in the more or less rapid spread of the symptoms within the plant. Botjes (4) described the cause of the occurrence of dwarf mosaic-diseased potato plants. He states that during the last 15 years Eigenheimer potatoes at Oostwold have been



observed to suffer both from simple (X) and mild mosaic, and grafting experiments showed that plants affected by these diseases also contain the stipple streak virus in masked form. Affected plants are noted by their stunted, dwarfed growth and by the clustering of the undulating leaves, especially near the tops of the abnormally short stems. This trouble appears to be identical with curly dwarf. Tubers from dwarfed plants gave rise to progeny of a similar growth habit, whereas tubers from mosaic plants yielded a predominantly mosaic stand with a sprinkling of dwarfed individuals. It was conclusively shown by grafting experiments that curly dwarf arises from a combination of the viruses of ordinary mosaic and stipple streak.

Whitehead (19) reviews the virus problem in relation to seed potato production in North Wales. An effort to produce high quality of potato seed tubers was started in 1927 in North Wales. The great majority of farms have now less than 1 per cent disease. This success is considered to be partly caused by the pastoral character of the country, which has facilitated the isolation and inspection of the small acreage of potatoes grown on each farm.

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## EFFECT OF PRECEDING CROPS ON YIELDS OF GREEN MOUNTAIN POTATOES<sup>1</sup>

G. F. LEA AND T. E. ODLAND

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A good rotation is an essential part of a potato production program. Certain crops are better adapted to potato rotations as they do not influence the yields of a following crop of potatoes unfavorably. Investigators at the Rhode Island Agricultural Experiment Station have found that certain preceding crops markedly reduce the yield of a succeeding crop of potatoes. This deleterious effect is very pronounced in an acid soil—a soil condition maintained in this way

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in order to control scab. The after-effects of a crop in a rotation may be masked for a time by other crops but it will eventually show its influence. A knowledge concerning which crops are adapted to potato rotations should aid in the formulation of a good cropping plan.

The causes of a deleterious effect of a preceding crop have been explained by various investigators as being caused by (1) a nitrogen deficiency resulting from microorganisms, whose growth has been stimulated by crop residues high in carbohydrates, competing with the crop for available nitrogen; (2) a mineral deficiency created by crop removal of certain minerals in large quantities; (3) a toxic condition produced by the decomposition of crop residues or by the secretion of a toxin by the roots; and (4) an acid condition created by the removal of a larger quantity of basic than acidic elements. The cause of the deleterious effect in this experiment has not, as yet, been fully explained.

#### EXPERIMENTAL METHODS

This experiment was started in 1907. The plats were two-fifteenths of an acre in size with a three foot alley separating adjacent plats. Sixteen different crops were grown two out of every three years. During the other year each plat was divided into eight sections and four uniform crops grown in duplicate. The timothy, redtop, alsike, and red clover plats were discontinued in 1936, because of serious inter-contamination and the difficulty of maintaining clean stands. The squash plat was also discontinued in 1935 since it has been too uncertain to give reliable information on its after-effects on following crops.

A 4-5-5 fertilizer applied at the rate of one ton to the acre has been used since 1929. This fertilizer is not considered the best for potatoes; however, it was necessary to use one that would most nearly meet the requirements of the majority of crops in the experiment. Lime has not been applied since 1917. At that time the plats had nearly a neutral reaction. Since then the plats have gradually become more acid until the pH is now about 5.3.

#### EXPERIMENTAL DATA

The average yields of potatoes calculated in bushels to the acre for the three years 1930, 1933, and 1936 are presented in table 1.

TABLE 1.—*Acre yields of Green Mountain potatoes following sixteen different crops*

Preceding Crop	1930	1933	1936
	Bushels	Bushels	Bushels
Onions	390	345	469
Potatoes	382	270	384
Mangels	369	306	407
Rutabagas	383	250	329
Cabbage	324	316	440
Buckwheat	362	344	430
Corn	391	302	358
Millet	327	267	293
Oats	462	342	445
Rye	453	341	438
Carrots	361	344	371
Redtop	432	320	—
Timothy	396	270	—
Squash	466	339	—
Alsike Clover	327	265	—
Red Clover	325	276	—

When the yields of potatoes following a preceding crop of potatoes are taken as a standard, the data in table 1 show that onions, oats, winter rye, redtop, and squash showed a beneficial effect on the following crop of potatoes. Rutabagas, millet, alsike, and red clover have, with two exceptions, decreased the yields of a following potato crop. Mangels, cabbage, corn, and carrots occupy an intermediate position for they have increased, as well as decreased, yields. Why these latter crops produce so variable an effect has not been explained. The differences in the growing seasons may, in part, be responsible. A less favorable season, such as 1933, may mask the effects of certain crops.

The yields in table 1 have been converted to relative yields for each year and presented in figure 1. Each year the yields of potatoes following potatoes have been taken as 100. In this form it is comparatively easy to see which crops have been beneficial or deleterious to a following crop of potatoes.

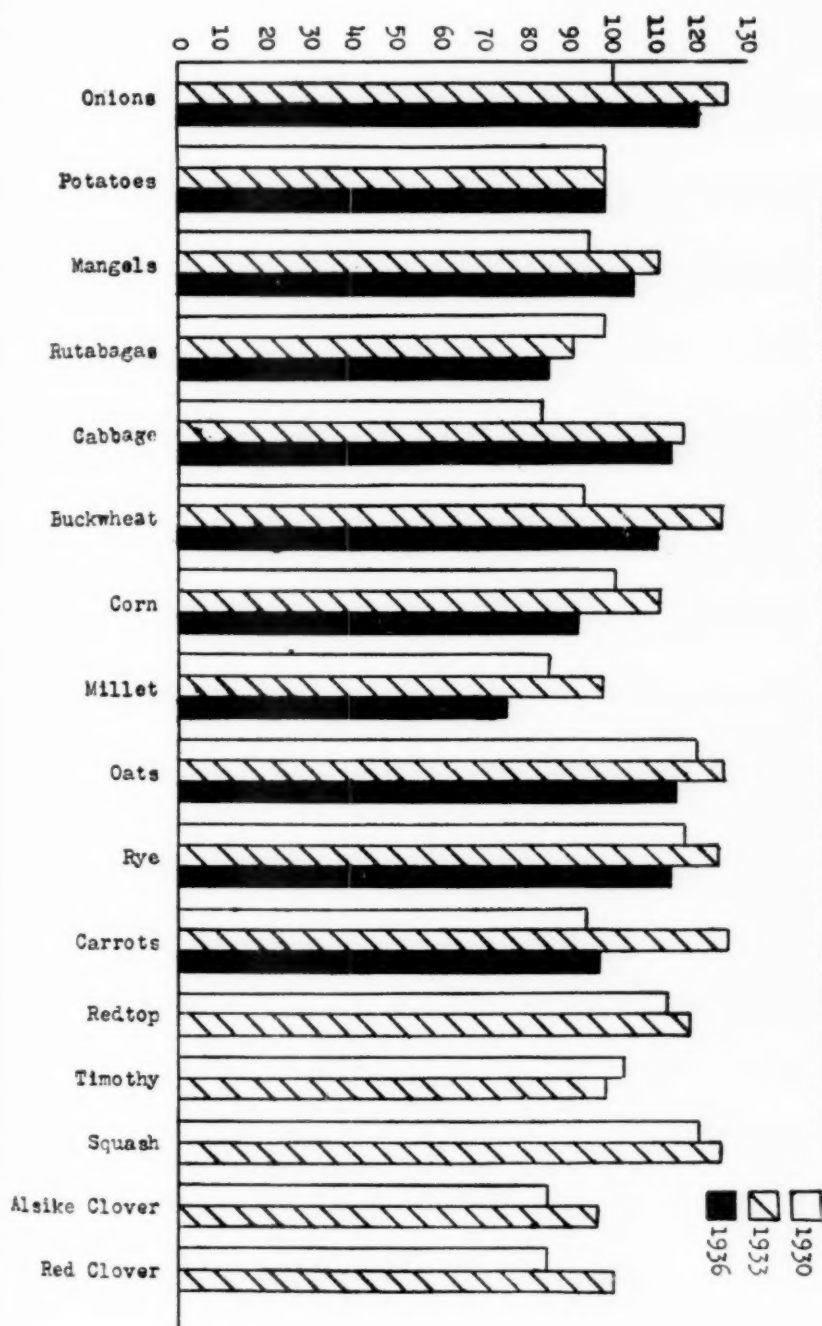


FIG. 1.—RELATIVE YIELDS OF GREEN MOUNTAIN POTATOES FOLLOWING SIXTEEN DIFFERENT CROPS

After the four uniform crops had been grown on the potato plot, it was possible to ascertain if the deleterious or beneficial effect was produced in one year; also, whether it carried over into a second season. The data for the years 1931, 1932, 1934, 1935, and 1937 are presented in table 2.

TABLE 2.—*Effect of growing certain crops one year on yields of Green Mountain potatoes the following two years*

Preceding Crop	Bushels per Acre				
	1931	1932	1934	1935	1937
Corn	351	351	306	307	—
Rutabagas	355	315	285	303	—
Mangels	321	267	248	297	328
Potatoes	352	334	312	288	313
Carrots	—	—	—	—	303
Onions	—	—	—	—	349

The data in table 2 show that a beneficial as well as a deleterious effect is evident the following year and may be carried over into a second season.

The results obtained with the clovers in this experiment are substantiated by data obtained from certain rotation experiments. Two five-year rotations, each having similar crops in corn and potatoes but one including leguminous hay for three years and the other a non-leguminous hay, have not responded similarly in yields of Green Mountain or Irish Cobbler potatoes. Both rotations were begun in 1893, and, with the exception of nitrogen for the hay crops, have received the same fertilizers. A 4-8-8 fertilizer applied at the rate of 2000 pounds to the acre has been used for potatoes the last few years. From 1925 to 1929 the non-leguminous rotation produced an average of 344 bushels of Green Mountains on each acre and the leguminous rotation 312 bushels. From 1929 to 1937 the former rotation has produced an average of 336 bushels of Irish Cobblers to the acre and the latter 260 bushels.

It is quite probable that the use of red and alsike clovers which have acted as biennials and the use of lime following potatoes explain the reason for the after effects not being noted until 1925. The third year hay, which was largely timothy and red top, apparently

counteracted the effect of the clovers. The use of lime has kept the soil from becoming very acid. The more pronounced effects of the legumes since 1929 can probably be explained by the fact that alfalfa has been used in the seeding mixture since 1926. The result has been to increase the percentage of legumes. Consequently the percentage of legumes has been increased during the first two years of hay and replace approximately one-half the grasses with alfalfa the third year.

#### DISCUSSION OF RESULTS

Although many of the crops in this experiment are not usually found in a potato rotation, the grasses and clovers occupy a prominent place. In view of this fact, the results with the clovers are particularly interesting. However, where these crops are grown for green manuring purposes they undoubtedly would not have so deleterious an effect as they have had in this experiment where they have been treated as hay crops.

Hartwell, *et al* (1,2) have shown that lime and heavy applications of superphosphate overcome the effect of the previous crop. These practices are not applicable to potatoes as excess lime encourages the growth of the scab organism and very heavy applications of superphosphate become too costly.

Various workers at this station have attacked the problem from several angles. Wherever possible, Odland, *et al* (3) in 1933, statistically analyzed the former data in an attempt to correlate some factor or factors with the wide differences created by preceding crops. The acid-base balance of crops as well as the pH of the soil was determined to see if a crop which removed an excess of bases left the soil more acid than one which did not remove an excess. These workers concluded that this was important but that weathering was probably as great a factor. The results of former fertilizer studies led them to believe that insufficient nutrients, particularly nitrogen, were not involved.

#### SUMMARY

The effect of preceding crops on yields of Green Mountain potatoes for the years 1930, 1933, and 1936 have been presented. It has been shown that preceding crops of rutabagas, millet, alsike clover, and red clover quite consistently decreased yields whereas onions, oats, winter rye, redtop, and squash increased the yields of a following crop of potatoes. The results obtained with the clovers are substantiated by data obtained from leguminous and non-leguminous rotations.

The deleterious or beneficial effect was evident when certain crops were grown one year on the potato plat. This effect may be carried over into a second year.

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### THE SLOUGHING OF POTATOES

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Potatoes that fall to pieces when cooked in boiling water have generally been considered to be more mealy than those which remain whole during the cooking process. Sweetman (1935) found a significant correlation of  $+0.47$  even though the work of this division yielded a correlation coefficient as high as  $+0.62$  between sloughing and mealiness. The Red McClure grown in Colorado is a very marked exception to this, however. This variety is generally high in starch, quite mealy, and falls to pieces only to a very slight extent when boiled. Rathsack (1935) published the results of some work on this subject in which he showed that this property was caused by the turgidity of the tubers. He cooked whole, unpared tubers, of uniform size, in boiling water and then by a method he developed determined what he called "zerkochungsgrad" or degree of boiling to pieces. As a result of his work he was able to show that many samples of potatoes immediately after being harvested boiled to pieces badly, but during storage this tendency decreased. Rathsack explained this as being caused by the fact that potatoes expand during cooking because of the mere increase in temperature; turgid or crisp potatoes will not stretch enough to take care of the expansion and so burst. If the tubers are stored long enough to lose about 10 per cent of the moisture, or if they are treated with warm air to cause a loss of approximately this amount they will no longer burst. They will then become soft or wilty so that they will stretch instead of burst when the expansion takes place.

As a result of Rath sack's work, was conducted an experiment in this laboratory during the winter of 1937-'38 on two varieties of potatoes to see if the tendency for pared, diced tubers to slough, or boil to pieces, would decrease with time as the whole, unpared tubers did. The method used was to obtain 100 lbs. samples as soon as the work could be started and store them under moderately warm conditions—about 65° F. Twice a week some tubers of uniform size were taken, enough to yield two samples of approximately 500 grams of diced potatoes for each variety. The size of the pieces was as nearly 2 cm. on a side as possible. These cubes were placed in boiling water amounting to three times their weight, and cooked for 30 minutes. At the end of this period the contents of the kettle were dumped on a 1/2 inch mesh screen which was soldered into a large funnel. The potato passing through this screen with the water was filtered out and dried on a weighed filter paper for 40 hours at 100° C. The measure used for the amount of sloughing was as follows: weight of dry residue divided by weight of diced tubers, times 100.

The results are shown in the accompanying graph and indicate that this type of sloughing is also caused by the turgidity of the tubers. In other words it is apparent that the tendency to disintegrate when cooking, will decrease if tubers are stored in a relatively warm place for a period of time.

This work is not intended to be conclusive, but is intended to show that the work of Rath sack may have a very practical application in the cooking of potatoes.

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#### SECTIONAL NOTES

##### CALIFORNIA

At this time 1945 cars of potatoes have moved from the early section of Edison, as compared with 898 to 1937. At Shafter, shipments have amounted to 2057 as compared with 4343 last year, with Wasco having shipped 1087 cars compared with 2131 cars a year ago.

The yields from any of the three areas listed above, generally



speaking, are not so heavy as last year. The quality is not so good as 1937, due primarily to rainfall this year which the growers do not normally have to contend with in this area. It is my estimation that the rainfall confused the growers, first in connection with what the moisture content really was; and, second, because of the packing of the surface soil above the potato, which normally, under our irrigation practice, never gets water except from capillary attraction, or in other words, from an upward movement of water through the soil. We are having the same difficulty this year as we have experienced for the past few years, with a considerable break down of the potatoes during transit, probably caused by the so-called soft rot. (June 10).—M. A. LINDSAY.

Judging by the movement of the Shafter Potato Crop to this time, it would appear that the yields are not averaging nearly so heavy this season as they did last year and previous seasons.

Although some of the late fields are giving a good account of themselves, there are enough indifferent yields to hold the total production of Kern County down and estimates have generally been revised downward.

The week of the 13th of June promises to be the peak week and the bulk of the potatoes will have moved by the 1st of July. We estimate that somewhere between 1,000 to 1,500 cars may be carried into July—depending on weather conditions from the present time.

The Stockton Delta Potato Crop at this time is in fair condition, although a number of fields was considerably affected by an early infestation of aphids from which they have not fully recovered.

The earliest fields in the Stockton Delta will be ready for harvest by the end of June, but no movement of any magnitude will take place until the middle of July.

The large growers in the Stockton Delta have expressed themselves as being opposed to the Potato Marketing Agreement, as the total volume of potatoes shipped from this District to interstate points is too small to justify the expenses involved. (June 11).—E. MARX.

#### INDIANA

At present we are in the middle of our late potato planting season and the conditions are very favorable. We have had timely rains and ideal potato weather. How much of an acreage will be planted is unknown at this time, but there is no doubt that there will be fewer acres



with larger yields. Flea beetle and leafhopper control have been a problem but our better growers are fighting these pests and are obtaining good control. Early planted potatoes are now being harvested in small quantities from the southern part of the state, but the bulk of the crop will not move much until the first part of July.

Our growers are very silent concerning the potato program since most of our counties do not produce enough potatoes commercially to compete with other sections. (June 11).—W. B. WARD.

#### IOWA

Our spring was late and cool. The weather at present is favoring rapid growth of the potato crop, but in this locality we never know whether, after a spring of this nature we shall have enough favorable weather to produce 4,000,000 bushels or 12,000,000 before heat and drought clamp down upon us.

Just before this issue reaches the readers, Tolaas and I will have kept open house to 100 to 200 growers of northern Iowa and southern Minnesota, at our big Interstate Seed Potato Plots at Crystal Lake and Clear Lake, and will have held our third annual Cobbler Seed School. Our visiting speakers will be E. M. Gillig and E. J. Taintor of North Dakota; Messrs. Tolaas, Regnier, Nylund and Chaleen of Minnesota, the latter with moving pictures of certified seed production; Dr. H. A. Jones, in charge of potato and onion work of the U. S. D. A.; and Edward O'Neal, President of the American Farm Bureau Federation, who will discuss "Organized Agriculture and the Vegetable Grower."

Our leading project at present is to improve the Cobbler seed supply of our region, and incidentally the supply of certain other varieties and of the country's seed as well. Our bill has been entered in both houses of Congress. Iowa and the South are strong in agriculture, and so are the certified seed growers of the North. We suppose the bill will pass, but not at this session. It is sponsored by Senator Herring and Representative Biermann. Senator McNary, the Republican floor leader, has offered his support. We trust that certification officials will favor, and will advertise the project. They can do this safely and usefully if the seed growers are informed carefully of the bill's provisions. The amount involved is, at the maximum, 1/600 of the potato production of the U. S. A.

It would seem natural that hearings on the bill would come about the time we go to Richmond, to the Annual Meetings.

The text of the bill follows:

"A BILL FOR AN ACT FOR THE IMPROVEMENT OF  
THE CERTIFIED SEED POTATOES OF THE UNITED  
STATES.

"Be it enacted by the Congress of the United States:

*"Legislative Declaration:* It is hereby established that for causes at this date unknown certain provinces of Canada produce considerable quantities of seed potatoes in which stocks official inspectors find no virus disease for periods of five to fifteen years or more, whereas in the United States only a very few such stocks are known, for example, two such fields of the leading variety, in all the United States in 1937, and they of Canadian origin.

It is also established (1) that virus-free foundation seed (like pure-bred livestock) is essential for the production of high grade certified seed, and (2) that high grade certified seed is essential to the production of the quantity and quality of potatoes needed by the people of the United States; and moreover, (3) that the importation of virus-free seed potatoes is cheaper than their production in any place or by any method at present known in the United States.

*"Duty Free Import of Certain Seed Potatoes:* Therefore, it is enacted that upon presentation of official Canadian certificate covering each carload, that the stock of potatoes from which such car came is Canadian grown and had been found free from all virus diseases for the past season and for four or more consecutive years immediately preceding; and upon presentation also of affidavit from the consignee of said car in the United States that such car would be used only for the purpose of growing seed potatoes,—such cars shall be admitted free of duty, up to a total number in any one seed season (viz. September 1 to the next June 1) of One Thousand Carloads of 36,000 pounds each. *"Provided,* however, that when the production of desirable virus-free seed in the United States, of similar official description has been achieved, and has been certified by the Secretary of Agriculture to the Secretary of the Treasury, the number of carloads admitted duty-free under this act, shall be reduced for the seed season following such production in the United States by the number of carloads of United States seed so certified."—C. L. FITCH.

MASSACHUSETTS

The potato crop in Massachusetts is developing under fa-

avorable conditions. Frosts, occurring during the latter part of May, caused injury to plants in scattered fields throughout the state. We are just beginning our spraying operations.

In general, potato growers are cooperating practically 100 per cent with the control program and are apparently favorably disposed toward it. (June 10).—RALPH W. DONALDSON.

#### NEBRASKA

The potato situation has continued favorable since the first part of May. Rainfall has been quite general over the potato areas of western Nebraska, and the reserve moisture in the ground is practically sufficient for a good crop, providing, of course, that unforeseen difficulties do not arise.

Potatoes are being planted at this time throughout the territory and a few growers have already completed that operation. The majority of the growers will be finished planting by the 20th of June, unless weather conditions interfere.

The indications are that the dry land acreage entered for certification will be increased above that of 1937, but will still be below the acreage prior to 1934. A further increase of acreage entered for certification under irrigated conditions is also indicated. The total acreage entered for certification is still about 10 per cent below the 10-year average for this state. If we have normal growing conditions this summer, however, the production will probably be higher than the average.

The acreage of commercial potatoes planted under dry land conditions has been increased, but is still probably 25 per cent below that during seasons prior to 1934. Somewhat of a reduction is indicated in irrigated plantings at this time.

Although no definite survey has been made, the writer is of the opinion that growers are very favorably inclined toward the Potato Marketing Plan. A hearing is scheduled in this territory for the 15th of June. The present indications are that there will be a favorable vote on this plan when a referendum is called. (June 13).—MARX KOEHNKE.

#### NEW JERSEY

Generally low temperatures with an abundance of rainfall have resulted in an unusually large vine growth for this time of the year. Most of the seed planted has been good but some growers have complained of an excessive amount of leaf roll in certified Chippewa's.

Meetings are now being held to discuss the proposed marketing agreement and the growers will be given an opportunity to vote on the question some time in July. It is impossible at this time to predict which way the vote will go. A large number of the growers favor shipping point inspection, but there is a question as to how this can be enforced in the case of small lots moving interstate by truck. The majority of the growers are cooperating in the control program. (June 15).—W. H. MARTIN.

#### NEW YORK

At this date potato growers in western New York are well advanced with their planting operations. Weather conditions have been especially favorable this year, although the rainfall was below normal during May and still is, to date. The acreage planted will be very little, if any, below normal. Fertilizer salesmen report increased sales this year which means either more acreage or heavier applications.

Hearings on marketing agreements affecting the 1938 crop have been scheduled at Albany, Cortland, Malone and Warsaw. The final growers' referendum will be taken in July.

The Ninth Annual Potato Field Day of the Empire State Potato Club has been scheduled for the 11th of August at Orchard Park in Erie County. It will be held at the Yates Farm on U. S. Route 20, a few miles southwest of Buffalo. Potato machinery demonstrations will be a major attraction. Governor Herbert Lehman will give the principal address on the noon program. The Yates Farm is the largest single unit farmed in western New York. This farm consists of 3200 acres, about one-third of which is cropped. From the Central point of the day's activities, visitors will be able to get a bird's-eye view of a 75-acre potato field planted wholly to certified seed of the Rural variety. Local farm bureau committees are expecting an attendance of ten thousand people. (June 10).—E. V. HARDENBURG.

#### NORTH DAKOTA

Potato growers in North Dakota are planting a rather normal acreage of both certified seed stock and table stock this year. In all the potato growing sections of the state there has been an abundance of rainfall. Field and weather conditions are, therefore, ideal for the production of a good crop.

With respect to the seed potato situation, it is apparent that

the state will produce a crop which will be vigorous and healthy so far as disease is concerned. The plants are still in their early stages of growth, but are giving every evidence of a healthy condition.

On the 24th of June the Federal Government will hold a hearing at Grand Forks to take evidence with respect to the wishes of our growers on another marketing control program for the 1938 crop. It is hard to say what the vote will be in this state, when it is taken. There is no decided opposition to the program on the part of the growers, and judging from this evidence, the program may again be approved. (June 9).—E. M. GILLIG.

#### OHIO

Frost during the middle of May caused considerable damage to the Cobbler crop in southern Ohio. The plants in a few fields were completely killed but most of the injury was limited to the leaves. Since that time, the weather has been ideal,—cool, and with plenty of rain. The crop has made a remarkable recovery and at least 90 per cent of it should produce normal yields. The heavy rains in northern Ohio have delayed the planting of the late crop and much seed is still to be planted.

Hearings on the proposed "Potato Marketing Agreement" will be held this week. There seems to be a general feeling of indifference concerning the agreement among the growers since Ohio ships only a few cars interstate.

Since the entire state is not to be included, but only the commercial counties, there will be interest in the method of determining which are to be included. Some growers along the Ohio River will object to their counties being included, because their local market is directly across the river.

Ohio growers use large quantities of small seed. There is a desire among growers to have a  $1\frac{1}{4}$  inch minimum on certified seed. There has also been criticism concerning the method of selecting the State-Grower Representative on the area committee. (June 13).—EARL B. TUSSING.

#### OREGON

I am unable to speak for the entire state of Oregon, although the Klamath district produces approximately 75 to 80 per cent of the potato shipments of the state.

Planting has been completed in the Klamath district, and a preliminary estimate would indicate that the total acreage at Klamath is slightly below that of a year ago, and possibly will not exceed a 5 per cent decrease.

The acreage of 1937 was 20,550 and I rather expect the acreage this year to be somewhere in the neighborhood of 19,500.

The general crop conditions are fairly good with approximately 50 per cent of the crop to date, above the average in appearance.

A formal hearing on the marketing agreement will be held at Klamath Falls on the 15th of May, and there seems to be interest in such an agreement at the present time. (June 11).—C. A. HENDERSON.

#### SOUTH CAROLINA

The South Carolina movement of potatoes has been completed and most growers managed to stay out of the red, although prices were rather low most of the season. As was expected, a large percentage of the crop was shipped in bags this year and the majority of growers seemed pleased with the resultant savings in the cost of containers and with the ease with which bags could be handled. Prices were fairly good for South Carolina sacked potatoes during most of the season. The yields on most farms were much lower than normal because of dry weather, coupled with a rather general infection of leaf roll. The weather during the harvesting season was good with the result that a clean, bright crop was harvested. (June 13).—MITCHELL JENKINS.

#### SOUTH DAKOTA

The acreage intention for potatoes in 1938 is approximately 24,000, compared with 28,000 in 1937, and 63,000 as an average for the period 1928-1932, according to the South Dakota Crop and Livestock Reporting Service.

The acreage of certified potatoes will be between 600 and 700, all of which will be in the area consisting of Clark, Codington, Brown, Day, Deuel, Hamlin, Brookings, and Kingsbury counties. Most of the certified fields will be planted to Bliss Triumphs and Irish Cobblers, Early Ohios, and Chippewas occupying a small percentage of the acreage.

A few fields of certified Bliss Triumphs were planted in early May with a view toward obtaining an early crop. Most of the certified acreage, however, was not planted until the latter part of May because of the rainy period during the middle of the month. Moisture conditions



have been excellent, to date, in most of the certified potato area. The early planted potatoes will be ready for the first inspection within the next two weeks and the later plantings are now well emerged.

Grasshoppers promise to be a serious threat and blister beetles will undoubtedly cause some trouble. It will, therefore, be necessary to provide considerable protection against insects by spreading poison bran and spraying and dusting. (June 11).—S. P. SWENSON.

#### TENNESSEE

The Irish potato crop in Tennessee is excellent this year. This is because of the abundance of rain and cool weather that has prevailed. The shipment of the early crop from Franklin, Winchester, and Decherd, in the central part of the state, is somewhat early on account of the excellent growing condition and the demand for the crop.

The second early crop on the Plateau is doing very well. The growers have had some difficulty in getting the crop planted because of the rains. (June 13).—A. B. STRAND.

#### VERMONT

Weather conditions for planting potatoes in Vermont were generally favorable. Plowing and fitting could be done earlier than usual with no interference from surplus rains. The plantings also probably average earlier this year than usual.

Certified seed was entirely disposed of by the latter part of May and many inquiries came to the Department of Agriculture after the supply was completely exhausted.

Practically the same number of samples of certified seed have been entered in the Central Test Plot at Randolph Center as for 1937. The number is between 80 and 90 and will represent probably about a hundred growers, inasmuch as one sample may stand for the seed of two or more growers. The tendency to reduce plantings in Irish Cobbles, which has been noticeable for several years, is again evident. In the earlier days of Vermont certification nearly as many Cobbles as Green Mountains were planted. Last year about half a dozen growers planted certified Cobbles and most of these were grown in small quantities. One reason appears to be that there is little local demand for Cobbler seed in the spring, and the price on quantity sales outside the state in the fall is usually low. (June 10).—H. L. BAILEY.

## VIRGINIA

The State Agricultural Statistician reports approximately a 20 per cent reduction in the white potato acreage on the Eastern Shore of Virginia.

The harvest season began much earlier than normal. The week beginning the 13th of June will see the bulk of the potatoes move from the district adjoining Cape Charles and South to Kiptopeake, with harvesting from there North occurring in normal sequence about ten days in advance of the normal season.

The crops grown from Northern seed are not so favorable as those grown from home-produced seed. For some reason the plants produced from Northern seed weakened, and did not make so large a growth and are dying much ahead of the normal season. This will limit the yield from Northern-grown seed beyond earlier expectations.

The potatoes produced from home grown seed have a better crop prospect at this time. They have not advanced to the point of harvesting, so the actual results are yet to be known.

The quality has been reasonably good, and the market demand has been excellent.

The fact that the government is holding the proposed marketing agreement in abeyance is not causing any particular reaction among the Eastern Shore growers. Although the vote on the Eastern Shore of Virginia was favorable,—19 per cent against and 81 per cent favorable—still, as a whole, it represented a very small portion of the potato growers. This agreement, as proposed, entertained but two important considerations, both of which are of primary importance in well-founded merchandising. One was the standardization of the goods; and, the second, prohibition of shipment of the class of potatoes which, under normal conditions, not only have no particular market value in themselves, but, when marketed, tend to destroy the sales price of the higher quality goods. With an active demand, such as prevails at the present time, this depressing influence is not felt. Under a less brisk demand, the effect would be very noticeable. As long as potatoes sell readily at a reasonable price there will be no demand for the agreement. In the event, or at such time as prices fall below a profitable level, the growers probably would ask both for governmental purchase of goods and for the agreement. (June 10).—G. S. RALSTON.

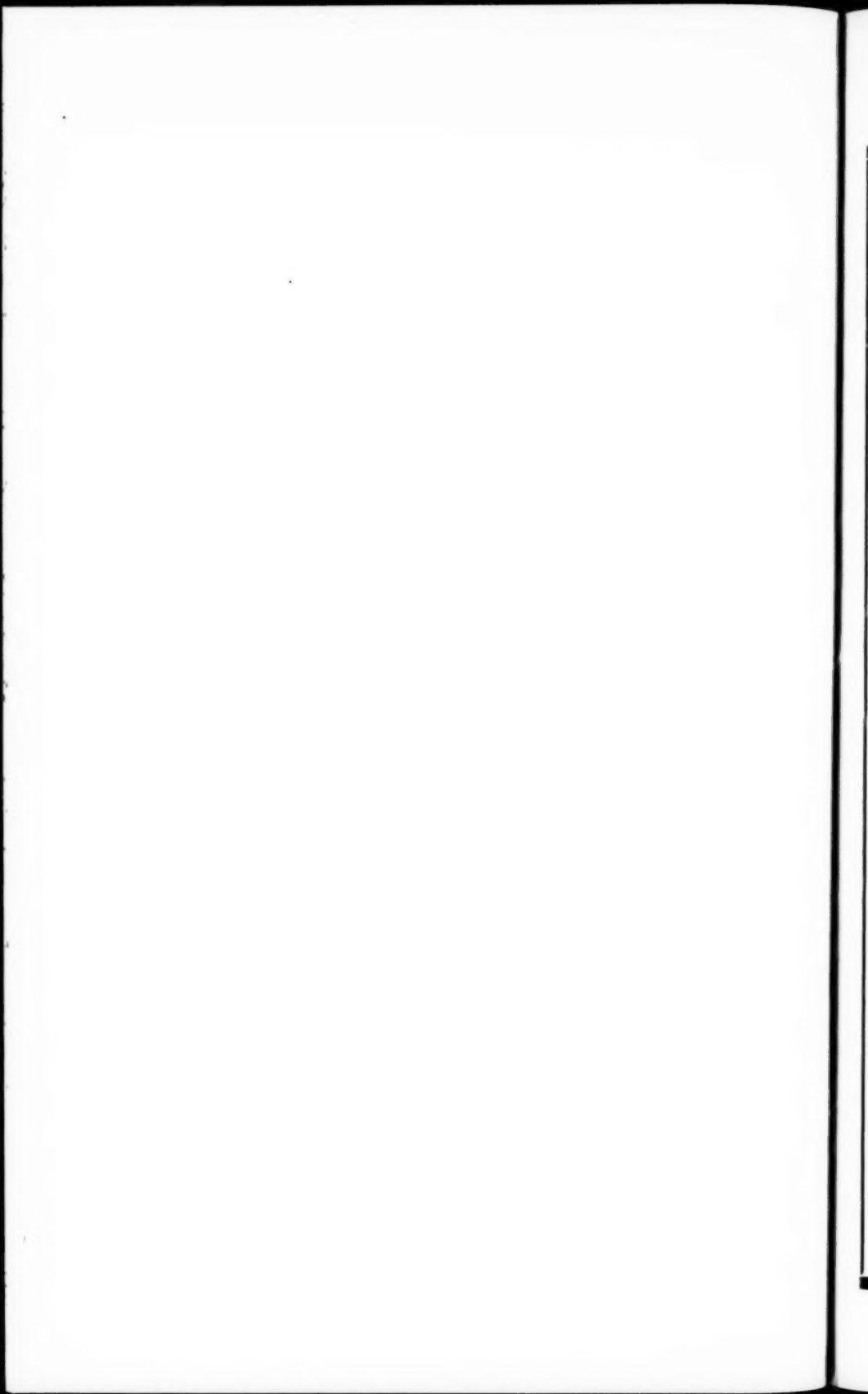


## WISCONSIN

Wisconsin potato interests will resume the annual State Potato Tour this year. Tentative arrangements provide that the tour will start in the Central District of Stevens Point on Tuesday, the 9th of August. The Tour will continue through the north central district on the 10th, 11th and 12th of August around the heavy certified seed producing areas of Antigo, Rhinelander, Starks, and Eagle River.

The first day, Tuesday, the 9th of August, will be devoted entirely to research field projects located in the central Wisconsin area. The final three days tour will be devoted to distinctly commercial phases of the industry including Certified Seed Production, and potato irrigation. Several of the leading potato growing farms of this area will be covered on the tour. Several important seed potato improvement and variety projects are located in this area, and field programs will be conducted at these locations.

At this date Wisconsin growers are taking a keen interest in a series of field conferences being conducted in the state prior to the Federal hearing on the proposed marketing agreement to be held at Antigo on the 20th of June. Ten regional meetings will be held in the state, prior to the hearing on the 20th of June. (June 9).—J. G. MILWARD.



# DID YOU APPLY ENOUGH POTASH ?

In the rush of planting did you use fertilizers containing enough potash to carry your crop through to a full harvest? If not, there is still time to apply this plant food, which is so essential to profitable yields. Side-dress with muriate of potash at the rate of 100-200 lbs. per acre. The fertilizer should be placed along the row about 3 inches from the plant and down 2 or 3 inches in the soil. This can be done conveniently by means of a fertilizer attachment on the cultivator.

Potatoes are greedy feeders on potash and remove from the soil more of this plant-food element than both nitrogen and phosphoric acid combined. To insure a good crop of No. 1's, at least 200 lbs. of actual potash ( $K_2O$ ) must be available in the soil. While best results usually are obtained when potato fertilizers are applied before planting, deficiencies of potash can be remedied by side-dressing if applied early.

Consult your county agent or experiment station about the fertility of your soils. See your fertilizer dealer or manufacturer. You will be surprised how little it costs to apply enough potash.

Write us for additional information  
and literature on how to fertilize  
your crops.



## AMERICAN POTASH INSTITUTE, Inc.

Investment Building

Washington, D. C.

**Pennsylvania Cooperative  
Potato Growers'  
Association**

INCORPORATED

BELLEFONTE, PENNSYLVANIA

**Certificate of Merit  
1937**



*The Pennsylvania Potato Growers are aware of the many contributing forces which are responsible for the advancement of the potato industry. Back of most of these forces is an individual or a group of individuals who have contributed more than is required or even expected of them. To register our appreciation and acknowledge the outstanding achievement to which such generosity invariably leads,*

**BE IT RESOLVED,** That this Certificate of Merit and Medal of Award be presented to

**Iron Age Division**

**A. B. Farquhar Company, Limited**

*For the knowledge exercised in developing a potato planter so well adapted to the needs of our industry.*

*Walter S. Bishop*  
President

*E. B. Brown*  
Secretary